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Distribution of algal aggregates under summer sea ice in the Central Arctic

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Introduction

Arctic sea ice is changing dramatically in the last decades and the consequences for the sea-ice associated ecosystem are difficult to assess. Sea ice becomes thinner, younger, and more pond covered. This allows more light to be transmitted into and under the ice. Combined with intensive melting this might impact the life of sea ice algae within the brine channels.

Algal aggregates underneath the sea ice of the central Arctic have been described sporadically, but the frequency and distribution of their occurrence as well as their role in the ecosystem remain unknown due to the lack of large-scale observations.

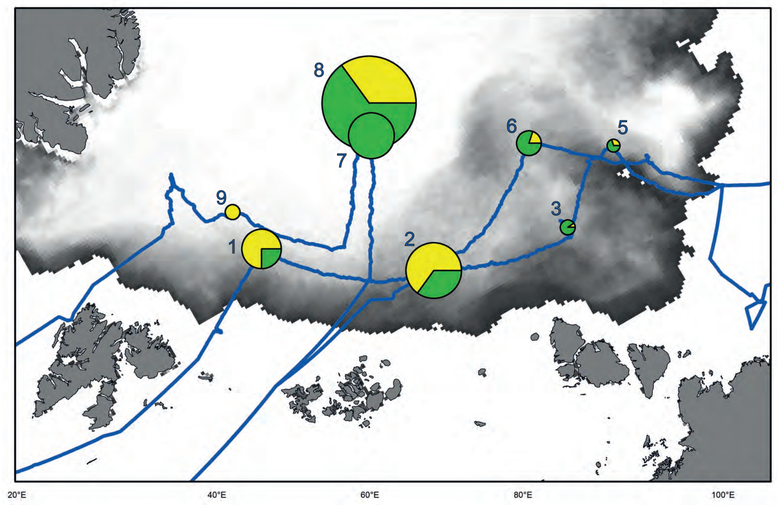
During the IceArc expedition of RV Polarstern in late summer 2012 (see map), we observed different types of ice algal aggregates underneath and attached to the underside of the sea ice with a remotely operated vehicle (ROV) underneath various ice types in the central basins.

Aggregate types

Round aggregates
mainly composed of pennate diatoms

Filamentous aggregates
mainly composed of *Melosira arctica*

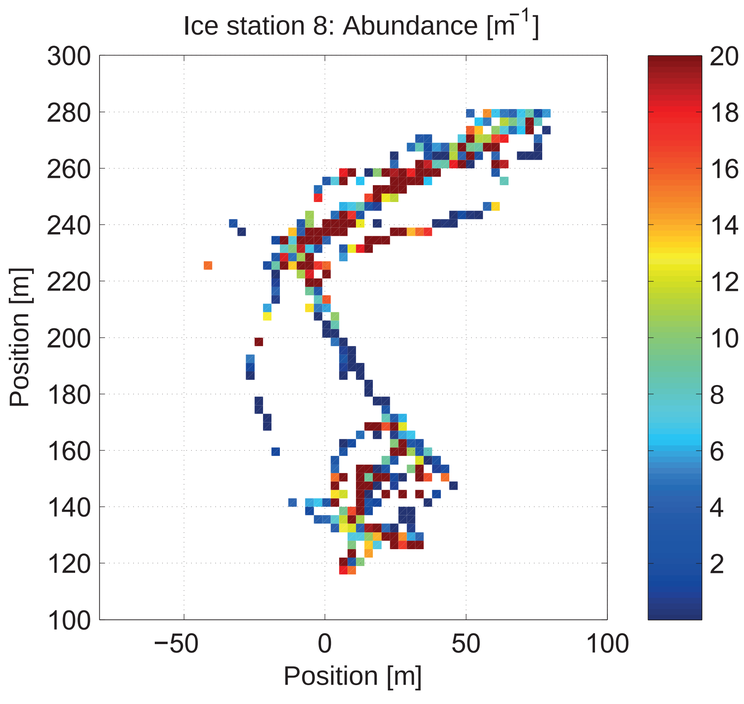
Large scale distribution

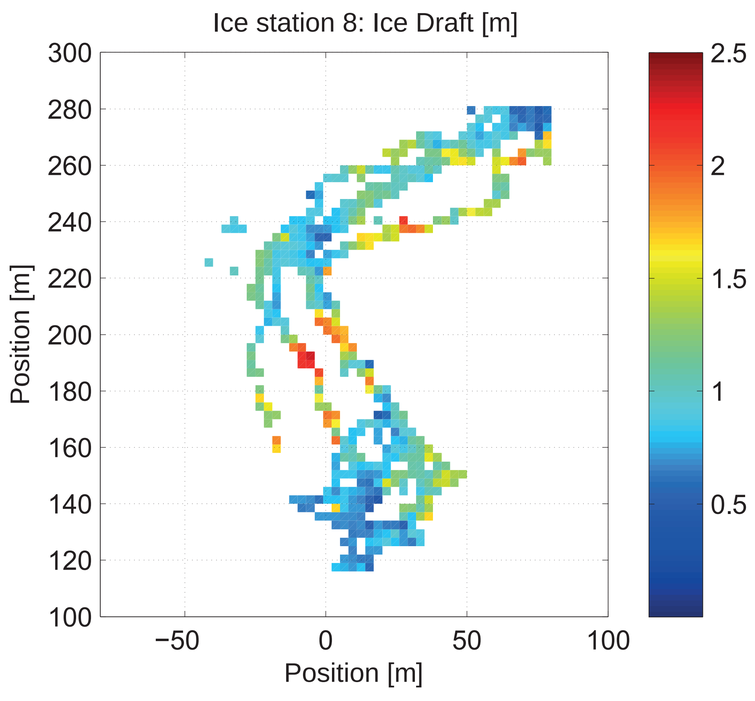


Mean abundance (diameter of circles) and aggregate type determined from ROV images. In the transpolar drift, round aggregates consisting mainly of sea-ice derived pennate diatoms dominated, while strings of *Melosira arctica* were dominant in the central pack-ice. The cruise track of the expedition and ice station numbers are shown in blue.

Floe scale distribution

Aggregates seem to be accumulated in level ice, that is surrounded by pressure ridges. Those locations offer protection from strong currents as well as higher light levels. No statistically signifigant dependence of aggregate abundance on physical habitat properties could be identified.



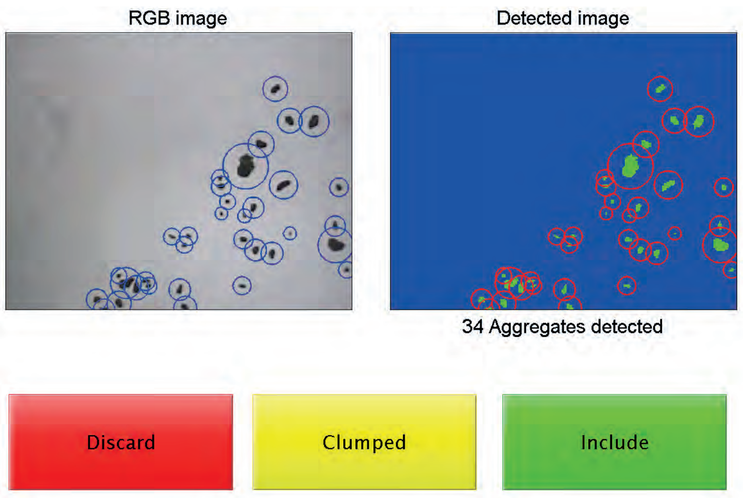


Conclusions

- Aggregate composition and biomass can be inferred from image analysis
- Floe scale distribution is influenced by ice topography
- Aggregate distribution is highly dynamic and does not correlate to any of the measured physical properties.
- Aggregate size distribution is related to buoyancy status of aggregates

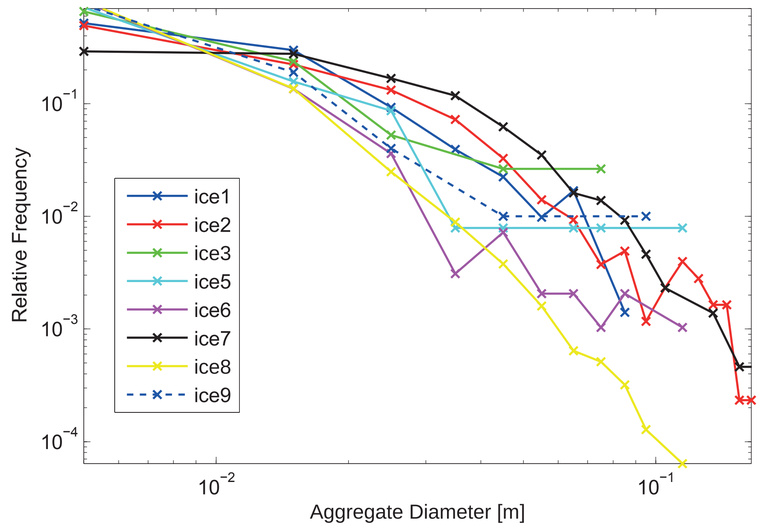
Aggregate detection from upward looking ROV-images

Upward looking images were obtained from a SD video camera onboard an Ocean Modules V8Sii-ROV. Physical properties of the habitat such as ice draft, light transmittance, salinity, temperature and dissolved oxygen were measured with additional sensors onboard the ROV.



Images were cropped and aggregates detected with a threshold algorithm. Size and shape properties of all detected aggregates were determined and the image registered to true scales using the measured distance to the ice.
Aggregate detection was checked manually and all incorrect detections were discarded. Aggregate abundances were gridded in 3x3m cells to account for repeated sampling of some positions.

Size distribution



The aggregate size distribution differs significantly between ice stations. Size distributions can give information about the buoyancy status and sinking regime. In our case they decline slower with diameter than usual for aggregating phytoplankton. Comparison with a phytoplankton aggregation model where sinking is disabled, supports the hypothesis that aggregates remain buoyant for some time before sinking.

References
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